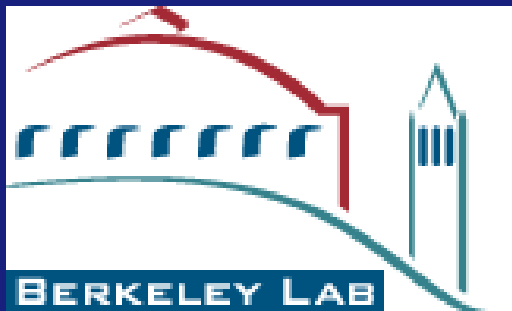


Emerging Technologies for California High-Tech Industries



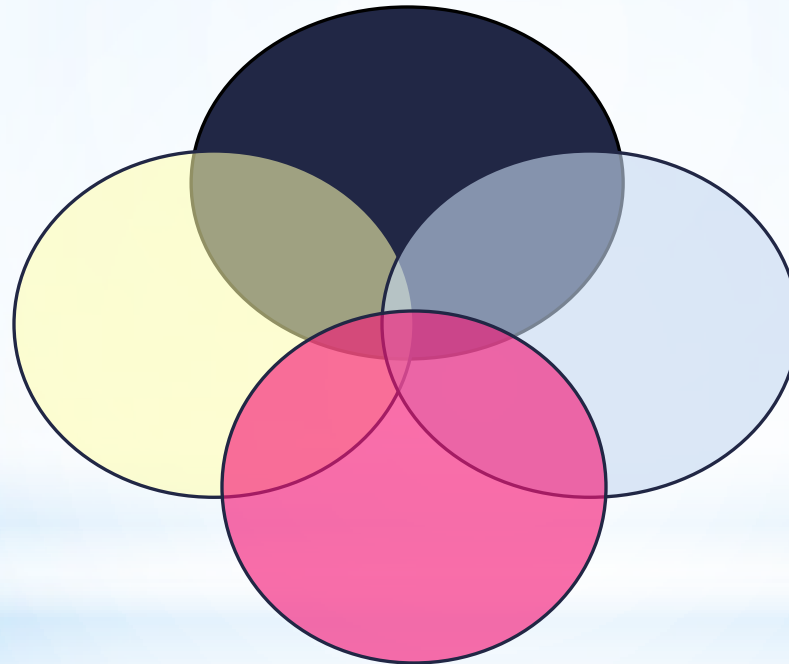
November 9, 2010
Bill Tschudi

HIGH-IGU BUILDINGS

data centers

cleanrooms

hospitals



laboratories

Industries Important to California

Large Energy Footprint in State

Continuous Operation

High Energy Intensity

Little Focus on Energy Efficiency

Common Infrastructure Opportunities

Process Energy Opportunities



AMBA HIGH-LEVEL BUILDING

- * High Process Loads
- * Uninterruptible Power
- * Stand-by Generation
- * HVAC
 - * Chilled water plants
 - * Reheat
 - * Free cooling
 - * Ventilation/air-change rates
- * Combinations
 - * data centers in labs or hospitals
 - * Cleanrooms (operating rooms) in hospitals

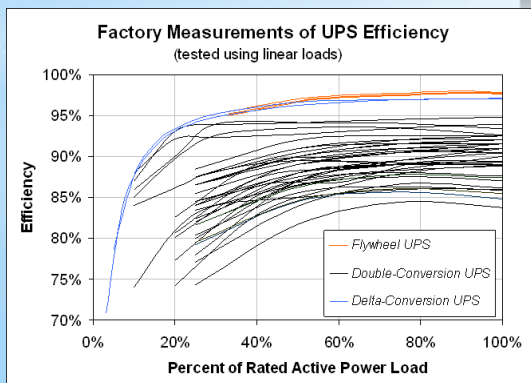
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- * Design Rules of Thumb – Lack of Science Based Design and Operation Criteria
- * Education – Awareness of Opportunities
- * Lack of Public Benchmark Data
- * Exempt from Building Codes
- * Resources Applied to Process/Mission
- * Lack of Integrated Monitoring and Control
- * Redundancy Options
- * Sizing Issues
- * Capital Cost vs Operating Cost

21W119L B9LL16L2 10 ELICIGUCA

- * First Energy Benchmarking for Labs, cleanrooms, data centers
- * Research Roadmaps for High-Tech Buildings
- * Spotlight on UPS systems and Power Supplies – led to Energy Star and 80 Plus Programs
- * Low Flow Fume Hood Research
- * Multiple Demonstrations of Emerging Technologies

BIER HIGH-TECH BUILDING 20CC62262



- *DC Power for Data Centers

- *Novel Control Strategies

- *Novel Cooling Strategies

- *Evaluating Modular Cooling – “Chill-off”

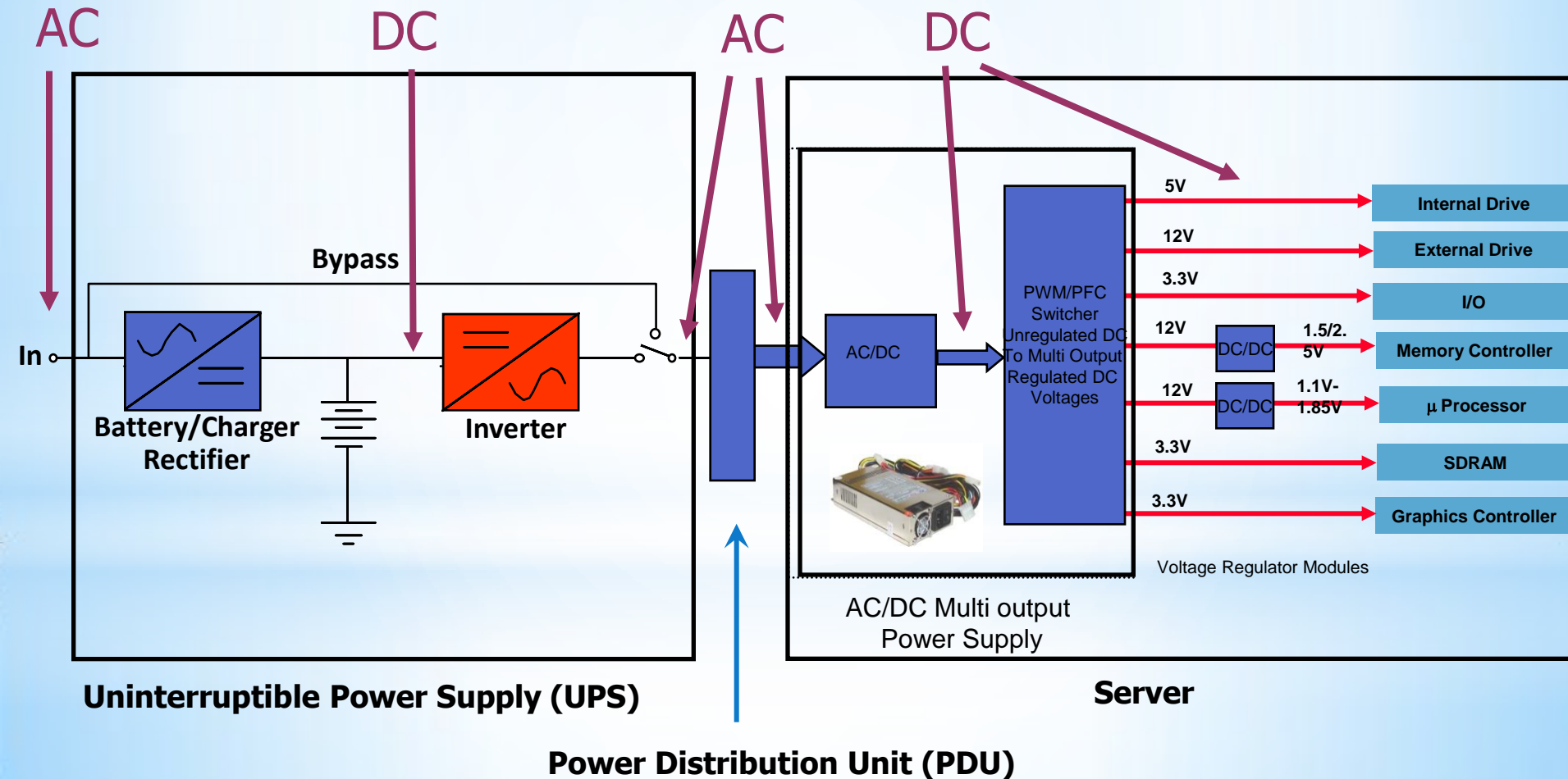
ENGINEERING TECHNOLOGIES DEMONSTRATIONS

DC Power for Data Centers

- Proof of Concept demonstration at Sun Microsystems
- Demonstration at UC San Diego – on-going
- Industry group advocating DC
- Emerge Alliance promoting 24V. and 380V. DC
- DC products being developed
 - Rectifiers
 - Power supplies
 - Connectors



DC Power Demonstration Seeks to Reduce Data Center Power Conversions



* Novel Control Strategies

- Use of Wireless monitoring and control – Demonstration at CA Franchise Tax Board
- Use of sensors in IT equipment to control building HVAC systems – Demonstration at Intel Corp.
- Use of wireless network to visualize thermal and pressure gradients – Demonstration at LBNL

ENGINEERING TECHNOLOGY DEMONSTRATIONS

Wireless Sensor Network:

- 50 wireless temperature sensors
- Intelligent control software

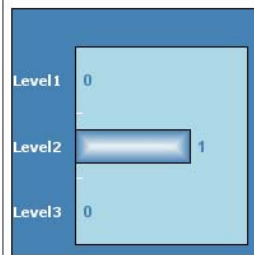
FACS Dashboard:

Currently in Auto.

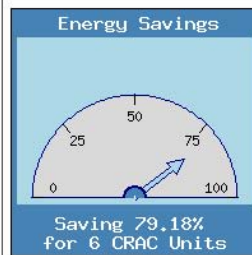
Click to Bypass.



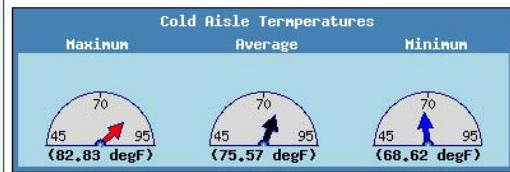
Alarms:



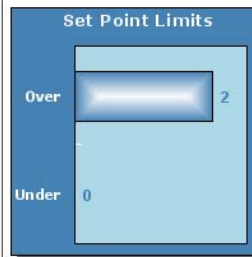
Fan Energy:

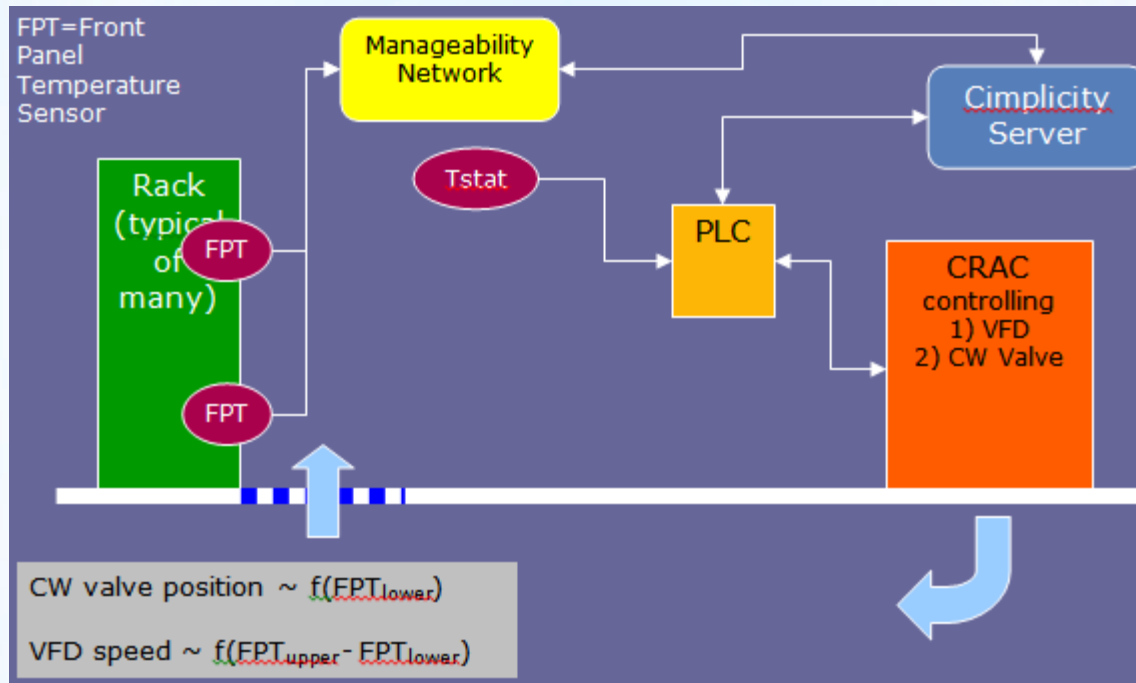


Temperature Summary:

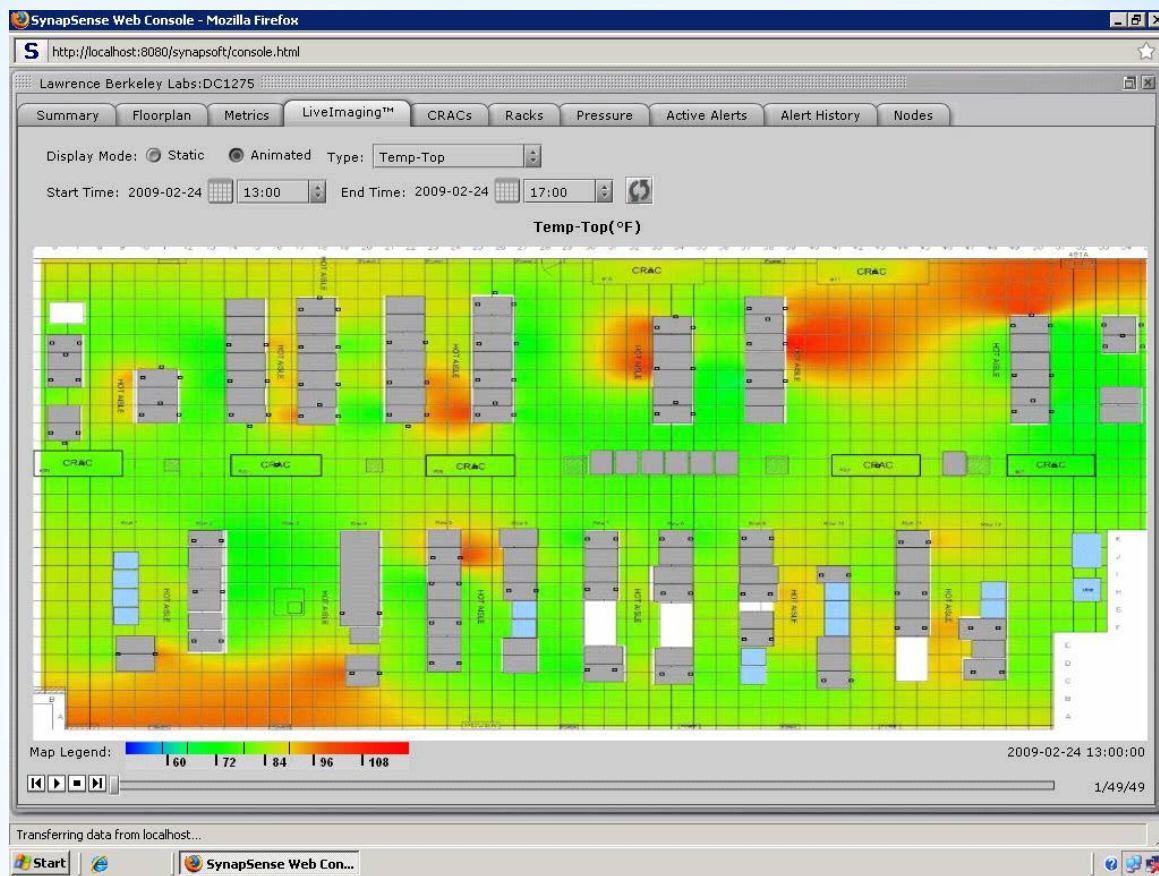


Temperature Limits:





DESIGN II HARDWARE TO CONTROL
COOLING HARDWARE

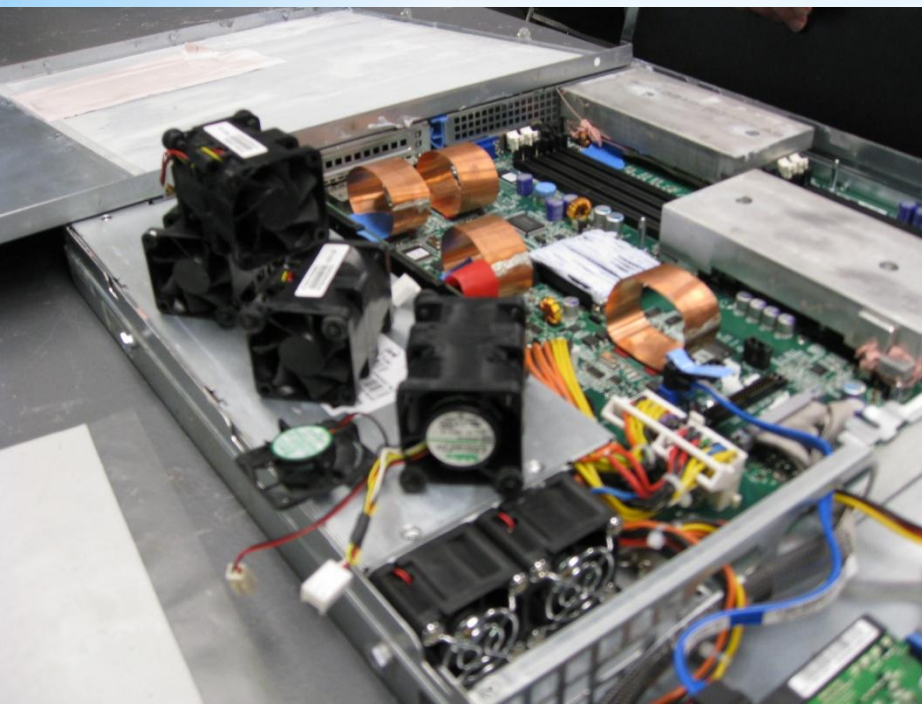


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*Novel Cooling – Clustered Systems

- Use convection to remove heat from servers
- Eliminate fans in servers
- Cool with higher temperatures
- Eliminate Compressor cooling

ENGINEERING TECHNOLOGY DEMONSTRATION



CIN2IGL6D 2A2IGW2

- * PIER and Utility Demonstrations of New or Underutilized Technology Help Overcome Barriers by Showing Technology Successfully being Used.
- * PIER and Utility Demonstrations have Stimulated Others to Try New Technologies. The Silicon Valley Leadership Group hosted a Data Center “Summit” Where Over 500 Professionals Learned of Demonstrations Hosted by End Users.

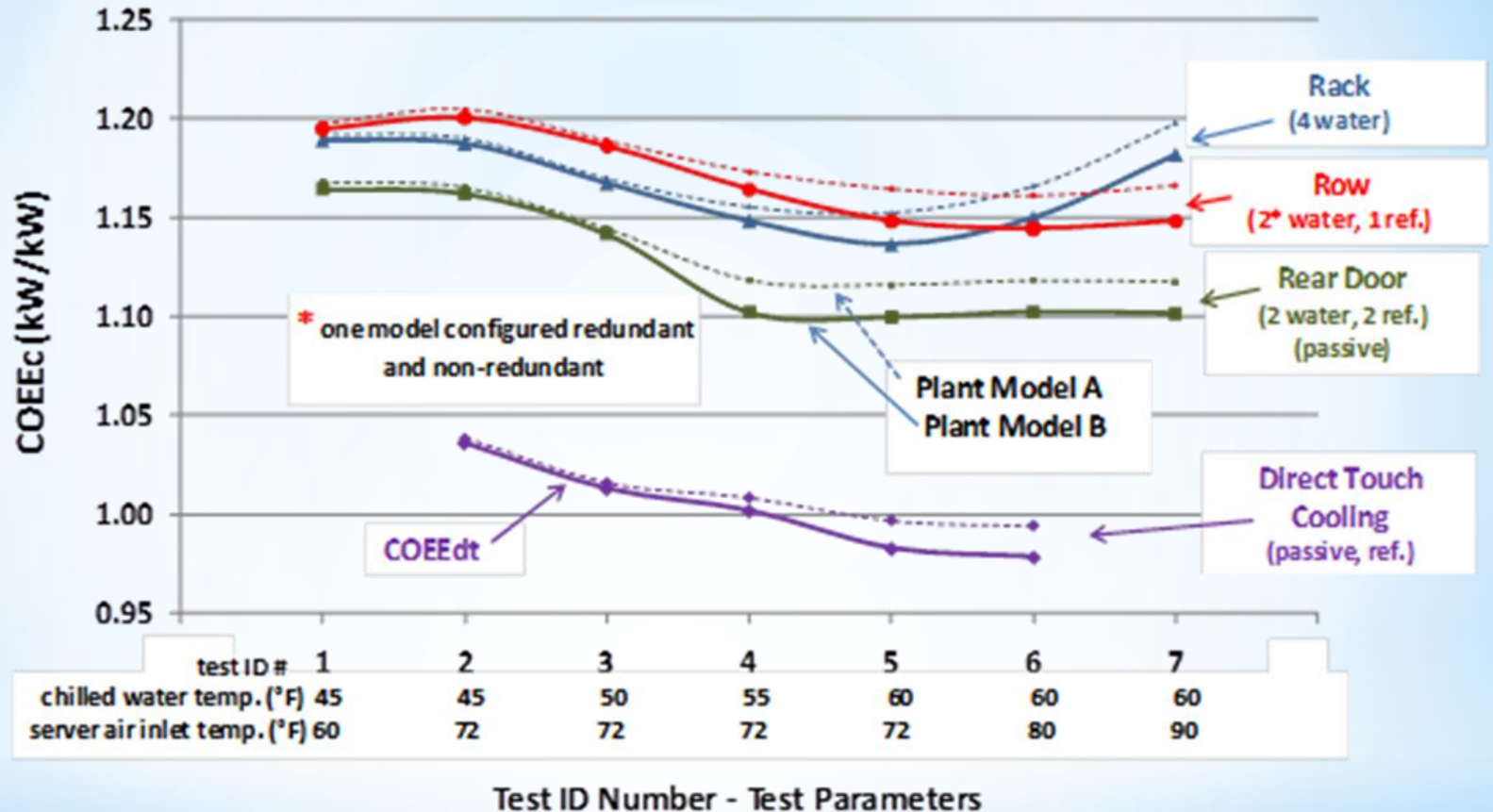
REGULATORS OF DEMONSTRATIONS

- * PIER Collaboration with SVLG to Arrange Demonstration Projects
- * Several PIER and Utility Demonstrations Presented
- * “Chill-Off” evaluation of Modular Cooling Solutions of particular interest to the Industry in past 2 Summits.

2016 DEMONSTRATION SUMMIT

COEEc - All Devices - Type Group Average

Chilled Water Plant A and B, No Water to Water CDU



Modular Cooling Closely Coupled
to the Heat Source is Much Better
than Standard Practice

CHILL OUT LIQUIDUS2

- * More Outreach and Training is Necessary to Get the Most From Current Technology.
- * More Innovation is Needed to Keep Pace With Growing Computational Appetite.
- * Collaboration with SVLG and other Industry Groups
- * Breaking Old Paradigms Will be Hard
 - Move to DC Power
 - Move to Liquid Cooling
 - More Use of Free Cooling
 - Move to Cloud Computing

AMUGLE DO M6 GO FLOW H6L6:

- * Continued Leadership of High-Tech Innovation is Important to California's Economy.
- * Public Goods Programs Play an Important Role in Focusing on Energy Since this is not Always High Priority to Industry.
- * Continuity and on-going Technical Advancement is Key as High-Tech industries evolve.
- * Public/Private Collaboration essential to Success.

COMMISSIONER OF THE HIGH-TECH

COMMISSIONER OF THE HIGH-TECH